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Software as a Service through the Cloud: who is responsible for what emissions?

Green ICT and ICT for Green Workshop

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Measuring and reporting emissions

GreenHouse Gas (GHG) Protocol as the **de facto** standard

Scope 1	Directly attributable emissions e.g.
Scope 2	Indirect but controlled emissions e.g. electricity
Scope 3	Indirect but not under control emissions e.g. delivery of goods

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Carbon footprint in SaaS environments

- How to allocate emissions among tenants of the same service?

What are the (Scope 3) emissions attributable to the tenants?

What to include in these emissions?

- How to measure the emissions of a service deployed on the cloud?

Across public and/or private cloud deployments?

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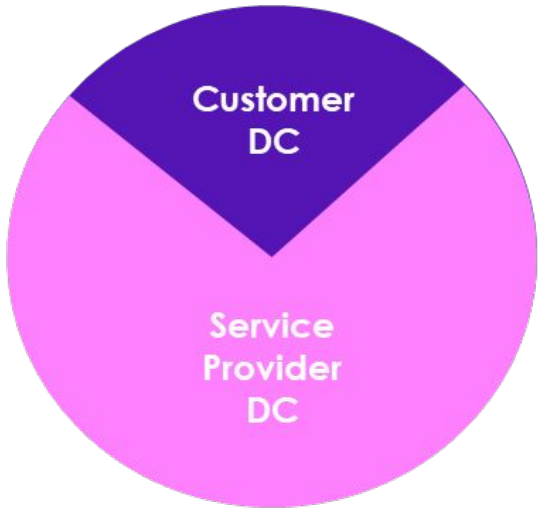
Collaboration with BT Global Services

Total Energy use = %age of Kilowatt Hours in 6 Data Centers

Measurable Energy Use Distribution



Carbon Emissions Data Fully Measurable

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Total Carbon Footprint (TCFP) model

Responsibility Share Equation

$$r = multitenancy\ share * L_{share}$$

$$multitenancy\ share = \frac{Tenant_{Scope2}}{DC_{Scope2}} \quad (2)$$

https://arxiv.org/abs/2305.10439

Total Carbon Footprint (TCFP) model

Scope 2 Equation

$$Scope2 = \sum_{DC \in DCs} ((E_{DC_{server}} + E_{DC_{network}} + E_{DC_{cooling}} + E_{DC_{misc}}) * c_{DC} * L_{share}) \quad (4)$$

https://arxiv.org/abs/2305.10439

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Total Carbon Footprint (TCFP) model

Total Carbon Footprint Equation

$$TCFP = Scope1 + Scope2 + Scope3 \quad (1)$$

Net Total Carbon Footprint Equation

$$TCFP_{net} = \sum_{DC \in DCs} (TCFP_{DC} - E_{DC_{green}} * c_{DC}) - REC * r \quad (7)$$

https://arxiv.org/abs/2305.10439

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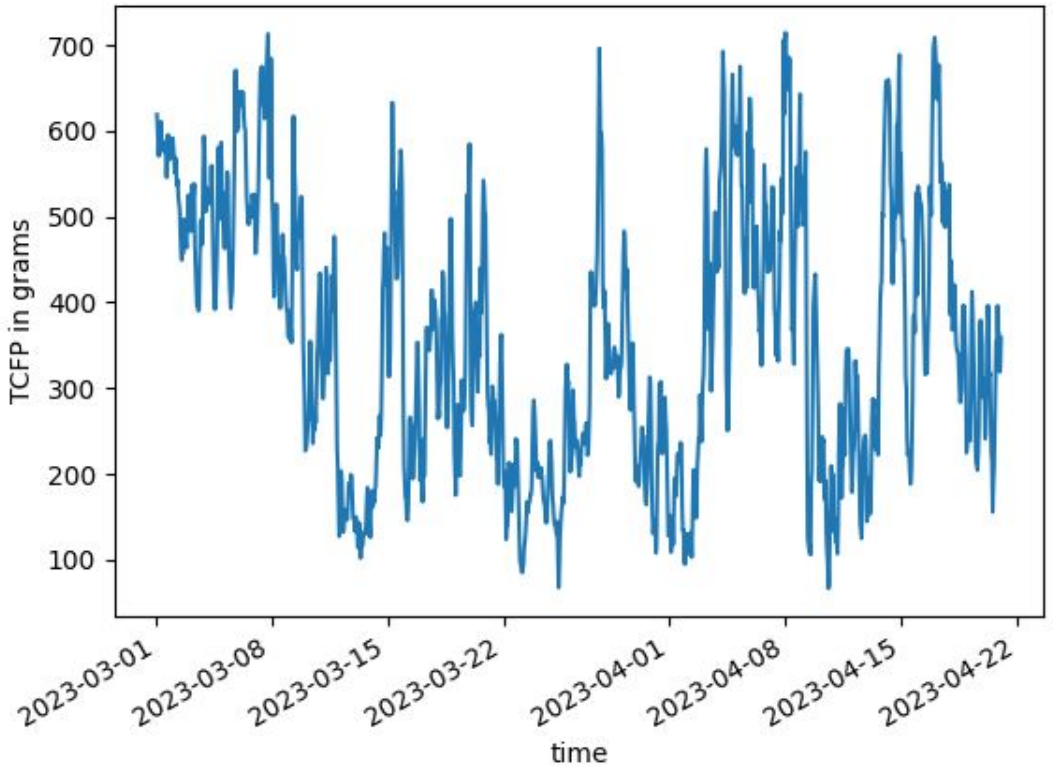
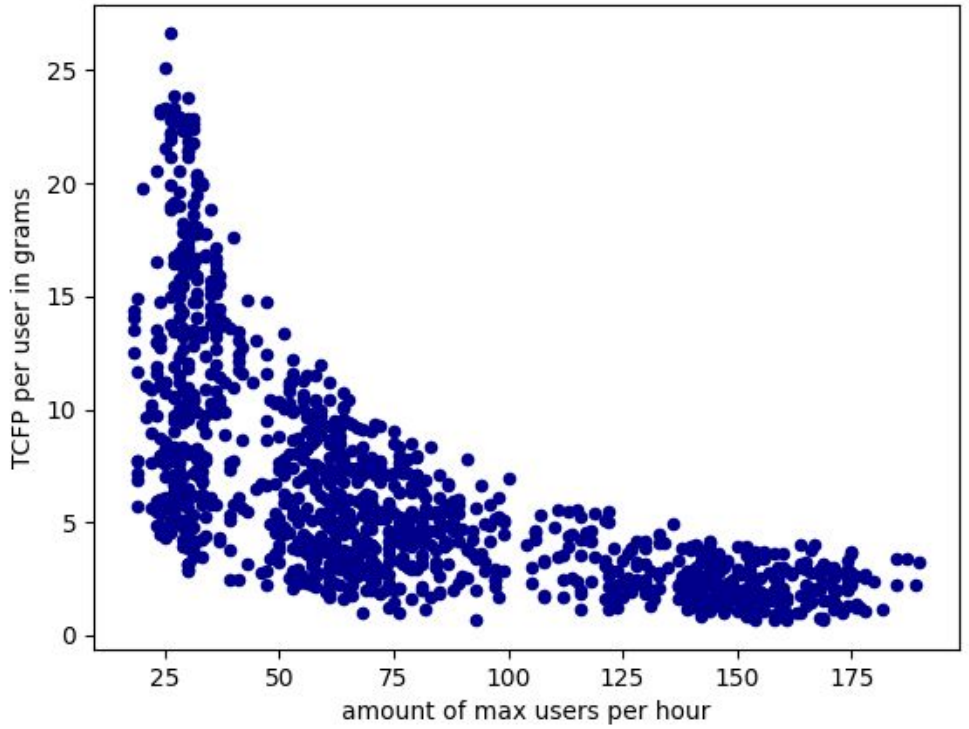
TCFP model in action





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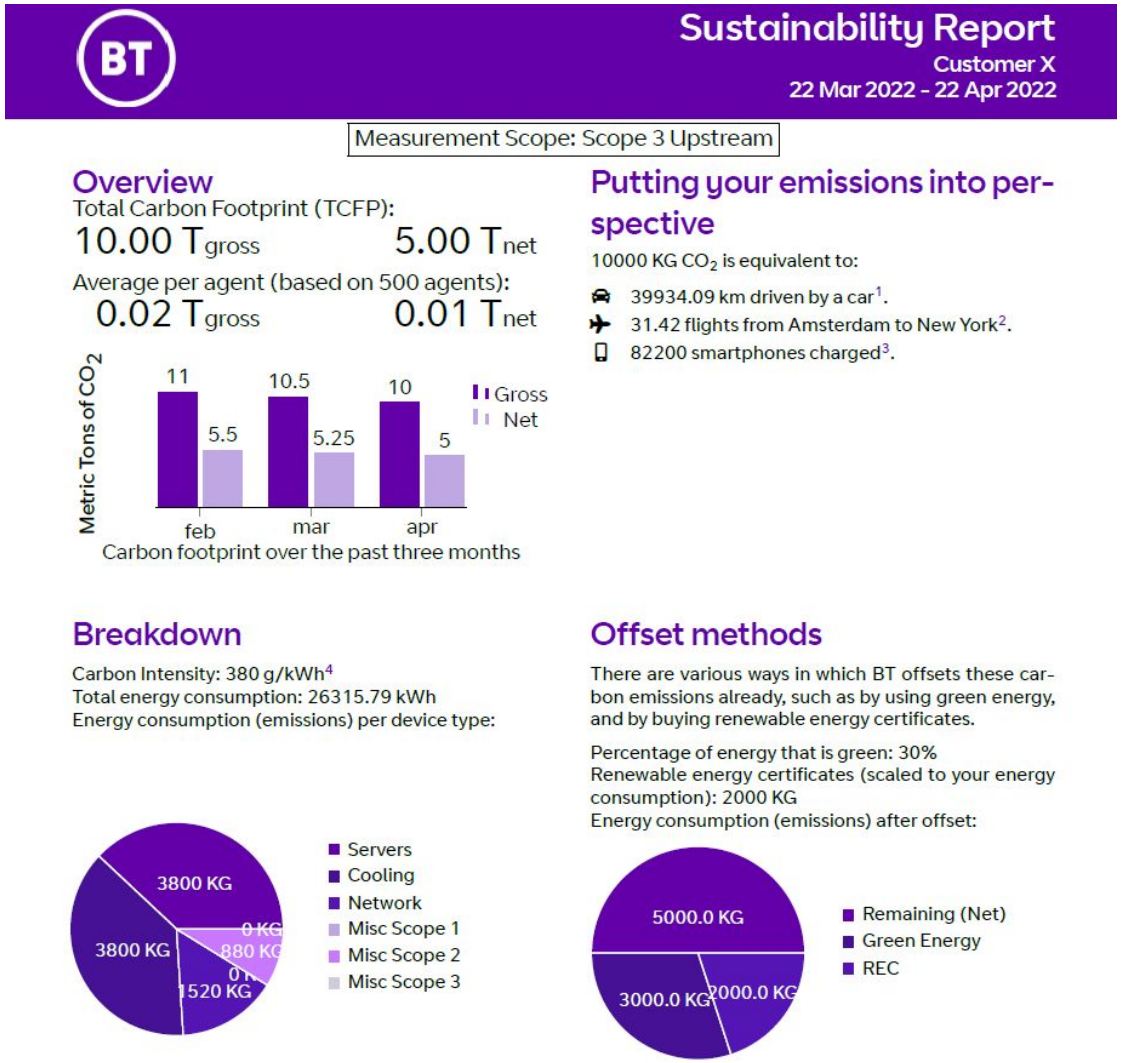
Report generator

Takes *utilization* or *energy consumption* data as input

Evaluated positively in a round of interviews with account holders



Going forward

- How to incorporate ***embodied emissions*** in a meaningful way?
- What is the impact of ***carbon intensity*** variability?
- What are the best practices for developing and operating ***carbon footprint-aware*** software systems?